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STUDIES IN LOGIC, GRAMMAR AND RHETORIC 57 (70) 2019

DOI: 10.2478/slgr-2019-0008

Robert W. Ciborowski
University of Bialystok
e-mail: r.ciborowski@uwb.edu.pl
ORCID: 0000–0002–5562–342X

Aneta Kargol-Wasiluk
University of Bialystok
e-mail: a.kargol@uwb.edu.pl
ORCID: 0000–0003–1915–2840

Marian Zalesko
University of Bialystok
e-mail: mzalesko@uwb.edu.pl
ORCID: 0000–0002–1488–173X

TIME, CAPITAL, AND TECHNOLOGICAL PROGRESS IN THE AUSTRIAN SCHOOL OF ECONOMICS

Abstract. The article investigates the significance of time, the nature of capital, and the role of technological progress in economic processes. The presented analysis of the three economic categories makes use of the theoretical achievements of notable representatives of the Austrian School of Economics, for whom a creative entrepreneur was the main protagonist of the interactions taking place in the economy. The above-mentioned economic categories, taken together, are for him the foundation of human activity. The time factor is of great importance for man – individuals constantly analyse historical events so as to attain success in contemporary economic reality, and in the future. Capital is the basis for economic calculation, which underpins all entrepreneurial activity. Technological progress, which happens in time and requires considerable capital outlay, is the driving force of economic growth.

Keywords: Austrian School of Economics, time, capital, technological progress

Introduction

The purpose of the article is to examine the significance of time, capital, and technological progress for economic processes. The three categories are assessed in the light of the theoretical achievements of the Austrian School of Economics. For the representatives of this school, a creative entrepreneur is the main protagonist of all economic interactions. In this protagonist's

perspective, the above categories are the foundation of human activity (entrepreneurship). From this standpoint, economics becomes a praxeological science. In the sphere of human activity, time proves that management is a dynamic process. Capital, regarded as a derivative production factor, plays a crucial role in human undertakings. By exerting influence on the original factors (land and labour), it lengthens the time of production, but has a beneficial impact on the effects of economic activity. Technological progress is an exemplification of time and capital since it requires certain expenditures, while the quality of newly introduced solutions can only be verified over time.

Time in economic processes

Time (*aiőn* or *chronos* in Greek) is one of the most significant factors of human activity. It stems from the thought of ancient philosophers (Aristotle and St. Augustine) that the notion of time is a praxeological one. Time should be perceived through the prism of changes (effects) constantly occurring in human affairs. From this point of view, human activity should be considered in the context of the past, present, and future. Economists, particularly those of the mainstream school, often forget about this and tend to analyse economic phenomena from an overly static standpoint. Meanwhile, economies develop in a dynamic manner.

The contribution of philosophy to understanding the notion of time is indisputable. Stanisław Czaja believes that this field of knowledge has added much more to our perception of time than economics or other social sciences. In his opinion, which seems to be well-founded, economics, focusing on relatively mundane problems of current economic realities, tends to overlook the importance of the concept of time, even though it eagerly uses it.[1] The problem of time looms like a huge unknown at the very core of economic theories.[2]

Without a doubt, time as a form of matter is a crucial component of economic life and an important factor in every economic system.[3] Its significance for economic phenomena is mainly analysed by such heterodox approaches as the Austrian school. Ludwig von Mises made the following remark on the meaning of time: "...the study of history provides man with signposts showing him the ways he has to walk along. Man can succeed only if his actions fit into the trend of evolution. To discover these trend lines is the main task of history."[4] Further, in the same book, he elaborated on the theme: "History's task is not to record all past things and events

but only those that are historically meaningful."[5] He defended the historical approach to socio-economic analysis and the rationale of using retrospection in studying economies, claiming that: "...detractors of history contend that preoccupation with things past diverts people's attention from the main task of mankind, the improvement of future conditions. No blame could be more undeserved. History looks backward into the past, but the lesson it teaches concerns things to come. It does not teach indolent quietism; it rouses man to emulate the deeds of earlier generations."[6]

Henry Hazlitt, discussing various approaches to explaining the changes taking place in economies, argued "...that many of the ideas which now pass for brilliant innovations and advances are in fact mere revivals of ancient errors, and a further proof of the dictum that those who are ignorant of the past are condemned to repeat it."[7]

Frederic Bastiat, regarded as a precursor of the Austrian School of Economics, also emphasised the role of time in economic activity. He remarked that the passage of time helped reduce the value of costly tools, irrespective of their physical wear and tear, because of frequent use. In so doing, he drew attention to progress in the development of applied tools, stating that devices created in previous periods were not able to compete with newer ones[8].

Eugen Böhm-Bawerk wrote that the value of goods did not only depend on their physical quality, but also on the circumstances in which they could satisfy people's needs. Goods of the same kind (and of similar physical quality) can have a higher or lower value, depending on the time and the place in which they are used. It is, therefore, obvious that "...if one and the same quantity of goods falls to the disposal of an economic subject at different points of time, its economical position will, as a rule, come under a different influence, and, in conformity with that, the goods will obtain a different value."[9]

Carl Menger insisted that the changes aimed at fulfilling the needs of people (e.g. the processes of transforming goods of higher order into ones of lower order) did not occur haphazardly but in a causal way. The notion of causality is inextricably linked to the idea of time, from which it follows that each process of change has its beginning and its end. These categories are associated with the flow of time. Thus, it is impossible to comprehend causal relationships within a process, or the process itself, without accounting for its temporal dimension.[10]

Ludwig von Mises is the author of the most noteworthy reflections on the topic of time. He wrote: "It is acting that provides man with the notion of time and makes him aware of the flux of time. (...) Action is always

directed toward the future; it is essentially and necessarily always a planning and acting for a better future. Its aim is always to render future conditions more satisfactory than they would be without the interference of action. (...) Man becomes conscious of time when he plans to convert a less satisfactory present state into a more satisfactory future state."[11]

Activity is part of the temporal order. Therefore, Mises suggests, it should be adjusted to the objective at which it is aimed and can be modified according to changing conditions. It is important, however, that the time between the emergence of new circumstances and the attempt to alter the mode of action is relatively short. This makes people's actions more rational and more profitable.[12]

A significant portion of human activity is dedicated to removing the discomfort of unsatisfied needs at a later point, or even in the most immediate future. A certain amount of time must pass between the moment an action is taken and the point when its purpose is achieved. It often happens that in order to attain the goal, one has to take many more steps than one. The process can be time-consuming, and then success is possible to achieve only through considerable perseverance. This leads to another significant factor of activity, i.e., time preference. People make decisions regarding the elimination of future discomfort taking two categories into consideration: *earlier* and *later*. It is frequently the case that satisfaction of needs in the near future is more valued than their satisfaction in the more distant future. Consequently, in many aspects of human activity, present goods are more desirable than future ones.[13]

According to Mises, "Time preference is a categorical requisite of human action. No mode of action can be thought of in which satisfaction within a nearer period of the future is not – other things being equal – preferred to that in a later period. The very act of gratifying a desire implies that gratification at the present instant is preferred to that at a later instant. He who consumes a nonperishable good instead of postponing consumption for an indefinite later moment thereby reveals a higher valuation of present satisfaction as compared with later satisfaction."[14]

Hans Herman Hoppe expressed a similar view: "Every actor requires some amount of time to attain his goal, and since man must always consume something and cannot entirely stop consuming while he is alive, time is always scarce. Thus, *ceteris paribus*, present or earlier goods are, and must invariably be, valued more highly than future or later ones."[15]

Among the stimuli which affect time preference, Hoppe distinguishes the following factors: external, biological, personal, and institutional. External factors are events which take place in the physical surroundings of an

acting man, over which he has no control (such events have an impact on time preference when they are expected, e.g. a flood). Biological factors are, technically, within the range of individuals' influence, but should be treated as independent of them (people are born, children grow up, become adults, and then grow old). Within the boundaries delineated by external and biological factors, one defines his or her rate of time preference, being guided by subjective judgements. The value of the rate of time preference and its changes throughout the life of a person depend on individual psychological factors. There are people who live in the moment, and there are those who concern themselves with their own and their children's future. Institutional factors of time preference are associated with the impact that other entities exert on individuals, and with the time spent waiting for the effects of that impact.[16]

To sum up this short overview, it can be said that time is a tremendously significant factor of human activity. As Friedrich von Hayek noticed, time provides a structure (order) for human activity. On the one hand, order is deliberately created by people, and on the other hand, it arises spontaneously, relying on the forces of nature.[17] Time has a strong bearing on the process of generating capital. It is also invaluable for the implementation of technical progress. It is a connector between the past, the present, and the future of human endeavour.

The concept of capital in the Austrian School of Economics

Throughout the development of the theory of economics, the term 'capital' has been ascribed a number of meanings. It is not a homogeneous category, as several types of capital can be distinguished. Today, dictionaries provide definitions of: industrial capital, equity capital, debt capital, loan capital, share capital, fixed capital, real capital, working capital, supplementary capital, initial capital, stock capital, nominal capital, venture capital, human capital, intellectual capital, personal capital, social capital, cultural capital, etc.

According to encyclopaedic definitions, 'capital' (from Latin: *capitale*) is one of the production factors, a source of financing assets. In ancient times, it was understood as 'the amount of money loaned'.[18] In the economic sense, 'capital' signifies resources exploited to produce goods and services. Although a number of meanings are attributed to the word, they all imply that capital is a resource, unlike income, which is a stream. In the widest possible interpretation of the term, capital also encompasses the

entire human population, i.e. intangible resources like skills, abilities, education, as well as land, buildings, machines, equipment, and all the stocks of goods, and finished and semi-finished products which are in the possession of households and businesses.[19] It seems that each of these kinds of capital contributes to greater prosperity since it enables its owners to acquire or produce consumer goods or transform these goods into the welfare of individuals.[20]

In classical economics, the sense of the notion of capital was examined by such authors as A. Smith, D. Ricardo, N. Senior, or J.S. Mill. The first of them strongly emphasised the role of capital accumulation for the division of labour and enhancing labour efficiency. Smith decided that capital accumulation derives from a surplus of production over consumption (economic surplus). Classical economists distinguished three categories of production factors: labour, capital, and land. D. Ricardo, however, made a further distinction between capital as the manufactured means of production and land as the "original and indestructible power of the soil".[21]

In the Austrian School of Economics, the theory of capital was founded chiefly on the work of E. Böhm-Bawerk, who significantly advanced the paradigm of the notion. That theory continued to be developed by his followers, but it is worth mentioning the achievements of Böhm-Bawerk's mentor, C. Menger, a truly individualist thinker.[22] His views on the concept of capital are best understood in the light of his theory of goods. Menger divided goods into those which are directly available in unlimited amounts and economic goods (ones which are scarce as their supply is limited). The latter, he claimed, could be further categorised as goods of the first order, which satisfy such needs as hunger or thirst (food, drink, clothes) and goods of the second (higher) order, without which it is impossible to obtain first-order goods, and which are therefore means of production.[23] Economic goods are ranked according to their importance for the satisfaction of human needs. That theory gave rise to a new understanding – other than the classical one – of capital. Menger defined capital as an available supply of higher-order goods which in the long term ensure the obtainment of lower-order goods. Therefore, capital was identified with a stock of production means.[24] The value of production means – as higher-order goods – is a consequence of transferring on them the subjective value of first-order (final) goods – the so-called theory of imputation.[25]

It is worth noting that the Austrians saw economic processes as an embodiment of original production factors in longer or shorter-lasting capital goods whose value or utility increase with consumption. The time interval which passes between the introduction of a production factor and the final

outcome of production is called the period of production. The longer it is, the more capital goods there are per unit of income. When the period of production is constant, income is directly dependent on how much capital was previously accumulated.[26]

As was already mentioned, Eugen Böhm-Bawerk, who significantly contributed to the development of the theory of capital, was undoubtedly a leading figure of the Austrian School. His works had an impact on the theory of economic growth and development. In the introduction to *Capital and Interest*, Böhm-Bawerk claims that everyone who owns capital is able to derive from it a steady net income (so-called annuity or return on capital). He comments on the terminological inconsistencies of "our science"[27], stressing, however, that in his research he assumes that the term capital signifies a group of manufactured production means, i.e., a group of previously created goods, not intended for direct consumption but for further production of new goods. He prefers this meaning of capital because of its purpose. Moreover, he makes a distinction between two 'shades' of capital: the socio-economic one, in which he includes the means which only serve to generate social income, and the individual one, which encompasses the means used for gaining personal income, i.e., goods thanks to which a person obtains other goods.[28]

Böhm-Bawerk goes on to explain the notion of the productivity of capital, saying that capital ought to be used to create assets and not to directly satisfy needs.[29] In his opinion, the process of production of goods involves two primary production factors: labour and land, and one derivative factor: capital. In itself, capital is not productive, but it links the original factors and allows for roundabout methods of production. Roundabout production with the aid of capital lengthens the period of production but brings better results.[30] Roundaboutness is a capitalistic method since it requires capital goods and is time-intensive (it is a more production-side method). Additionally, roundabout production processes are affected by the law of diminishing returns – the longer the process of production, the greater the output, but, as a rule, to an increasingly lesser degree.[31] Roundaboutness of production involves sacrificing today's consumption for manufacturing a higher number of investment goods, adapting new technologies, and undertaking longer production processes, which in effect should lead to greater consumption in the future.[32]

Böhm-Bawerk's heritage is reflected in the works of his most eminent followers, Ludwig von Mises and Friedrich von Hayek, among others. Mises emphasises that all economic categories are associated with human activity and are in no way directly connected with the physical properties of things.

Therefore, economics is not concerned with goods and services, but with the choices and actions of individuals.[33] As Mises observes when writing about Böhm-Bawerk's theory of capital, "Man chooses roundabout methods of production that require more time but compensate for this delay by generating more and better products".[34]

"At the outset of every step forward on the road to a more plentiful existence is saving – the provisionment of products that makes it possible to prolong the average period of time elapsing between the beginning of the production process and its turning out of a product ready for use and consumption. The products accumulated for this purpose are either intermediary stages in the technological process, i.e. tools and half-finished products, or goods ready for consumption that make it possible for man to substitute, without suffering want during the waiting period, a more time-absorbing process for another absorbing a shorter time. These goods are called capital goods. Thus, saving and the resulting accumulation of capital goods are at the beginning of every attempt to improve the material conditions of man; they are the foundation of human civilization. Without saving and capital accumulation there could not be any striving toward non-material ends."[35]

Mises stresses the fact that the term 'capital good' is not synonymous with the word 'capital'. One of his definitions of capital goods refers to them as "produced factors of production", as opposed to those obtained from nature (the land) and human labour. He also notes that the division into capital goods and consumer goods is not a rigid one as it does not rely on the physical and chemical characteristics of these goods. The classification depends on the situation of the users and the choices they make. The same goods can be either capital or consumer ones. Goods for immediate consumption are capital goods from the point of view of someone who treats them as a means to ensure survival for him and his employees in the intermediate waiting period.[36] In order to make it possible to implement processes of longer production and longer waiting periods, the volume of capital goods must be increased.[37] Mises concludes that capital is a fundamental notion of economic calculation and therefore the most essential tool of intellectual endeavours undertaken in the market economy and that it is associated with the concept of income.[38]

Böhm-Bawerk's theory was also developed by Hayek, who described capital as "a convenient description of the aggregate of non-permanent resources and one difficult to dispense with entirely".[39] He remarked that all the problems associated with the general notion of 'capital' stem from the fact that some of the production resources are non-permanent and must be

continually re-created for economic reasons. And thus it makes no sense to see capital as something permanent, which exists independently of the fundamentally non-permanent capital goods of which it consists. Secondly, an increment of capital will always mean an extension of the investment period – capital will be needed only to enhance production by as much as the investment period increases.[40]

Capital structure and capital controversy

Apart from the theory of roundabout production methods, another important achievement of the Austrian School authors is their research into the heterogeneous nature of capital. An emphasis on the heterogeneity of capital, i.e. the impossibility of standardising or aggregating it, is a notably distinctive feature of the Austrians. As R. Taghizadegan notes, the main theme of capital controversy is the question whether capital can be regarded as a homogeneous whole (homogeneous fund)[41] because such an approach, different from the views of the Austrians, was preferred by neoclassical economists.[42] R.C. Holcombe underlines that it was already Böhm-Bawerk who – by ushering the concept of heterogeneity – provided a framework for understanding capital structure. Heterogeneity was further examined by F. von Hayek and L. Lachman, among others. Hayek believed that capital is not a monolith, but a heterogeneous structure. He asserted that: [the majority of economists] "regard the stock of 'capital' as a quasi-homogeneous, quantitatively determined magnitude which can, like the supply of any other factor of production, be treated as a datum of economic analysis. One of the main conclusions of the whole of the preceding discussion is that the supply of capital *cannot* be treated as a single quantity in this sense".[43]

L. Lachman summarised the issue of capital in the following points:[44]

1. Heterogeneity of capital means heterogeneity in use – Capital is a means for attaining the subjective goals of an individual. Its physical properties are of secondary importance. Capital is not defined in material terms, but by the ways in which it is used.
2. Heterogeneity in use implies multiple specificity – The lower the order of a good, i.e. the closer it is to consumption, the more specific it will be. Specificity means that a good has a limited number of applications.
3. Multiple specificity implies complementarity – Two goods are complementary if they can be transformed into goods of lower order provided they are used in combination with each other.

4. Complementarity implies capital combinations – Since different specific capital goods require using other complementary goods in certain proportions, they only work in combination. Therefore, it is not the volume of capital but its correct combination that is a condition necessary to produce lower-order goods, i.e. satisfy needs and attain objectives.
5. Capital combinations form the elements of the capital structure – Capital is a structure which is not composed automatically but through human predictions, decisions, and actions.

Capital investments arise as a result of applying a certain specific capital structure.

Technological progress in the Austrian School of Economics

Progress (from Latin *progressus*) means 'moving forward'. It is, therefore, a change of a status quo into a new reality – a dynamic and, in principle, advantageous process.

To some extent, technological progress involves invention and innovation. The former is non-measurable because of the non-comparability of its various types. Besides, it is only a scientific or technical fact. Innovation, meanwhile, is primarily an economic phenomenon.[45] This is why invention should be treated as economically neutral. Using invention to pursue specific production goals is subordinated to the notion of innovation. Very frequently, invention is identified with new devices or discoveries, i.e. terms which are narrower than innovation.

The Austrian approach to technological progress can be presented in the context of the works by Ludwig von Mises, Eugen Böhm-Bawerk, and Joseph Schumpeter, although his perspective was slightly different, only vaguely akin to the Austrian School.

Initially, technological progress appeared merely as an element of superficial analysis of production techniques and the effects of this choice on the distribution of national income. It was only the emergence of the concept of production function that gave rise to simultaneous analysis of technological progress and economic growth.

Böhm-Bawerk's writings are particularly significant for the theory of technological progress. His approach is associated with his conception of roundabout production methods. They imply production of consumer goods by means of capital, which distinguishes them from direct methods based on original production factors. Roundabout methods make it possible to in-

crease the quantity and quality of output. It follows that greater productivity and technological advancement result from a widening of the range of roundabout methods[46].

Böhm-Bawerk's idea based on the theory of marginal productivity is identical to the assumption of the neoclassical production function that with a given amount of labour, a rise in capital results in a gradually declining output, both overall and per one unit of production input. Inventions shorten the time of production and quickly displace older techniques, lowering the cost of employing workers and boosting profitability.

Böhm-Bawerk also clearly discriminates between roundabout production methods given a certain level of technical knowledge and the impact of innovation on the speed of production. Introducing the concept of the production period, he assumes that the output of a capitalist economy can only be characterised by the original factors of production (labour and land).[47] This leads directly to the issue of time preference.

In an erratic economy, every now and again it is necessary to choose between different ways of satisfying needs, depending on the period of time. Depending on what results they expect, economic entities can decide whether to spend their incomes on consumption or accumulation, whether to gratify expectations now or later. This is determined by time preference because an acting man strives towards a more satisfying state, preferring goods produced earlier to those manufactured later, and more durable goods to less durable ones.

Time preference is associated with using investment capital.[48] Development of new, more efficient production methods requires investment, i.e., previously made savings. The amount of savings and investments is affected by time preference.[49] Thus, a positive rate of time preference is necessary to induce some entities to save more. The rate of time preference has an impact on the size of the premium which present goods command over future ones, thereby determining the level of investments and savings.[50]

Savings allow people to exchange consumer (present) goods for capital (future) ones. The premium thus earned and the anticipation of a greater number of goods in the future contribute to a decrease in the rate of time preference and a rise in savings and investments. The expectation of a higher real income causes the rate of time preference to diminish while the marginal utility of future money grows.[51]

This implies that people are more inclined to make choices the effects of which will be observable in the more distant future. What is more, investment decisions will regard increasingly more complex production processes.

Lower time preference and pursuit of more and more complex processes breed interest in new knowledge, information, and advanced production methods. Willingness to implement new ideas, sometimes based on solutions which are still unknown, paves the way for technological progress.

An aptitude for taking risks, which are inherent in technological progress, stems therefore from time preference and directly determines it. The effectiveness of technological processes enables one to pay more attention to investment possibilities, and thus a greater propensity to save.

There is another side to time preference: it is a consequence of the propensity to risk and reflects the genuine reactions of people making investment decisions. Hence, it is a more efficient way to raise the level of technological sophistication than any other exogenous (interventionist) factors. This is related to a reduction of risk and responsibility for achieved objectives, which do not occur in the case of interference. Namely, the readiness to make savings will not increase (preference will not decrease) and the realistic assessment of the results will be hampered. As long as interference (in property or production) does not take place, a downward trend of the rate of time preference, and the associated technological progress, will continue.

The consequences of interfering with time preference which have an impact on technological development are, therefore, as follows: the danger that the effects of progress will be intercepted by the interfering entity, a change of the character or mode of manufacturing processes, and a reduction of the role of risk in taking production decisions (transferring some of or the entire risk onto the interfering party).

The role and scope of the impact of time preference on technological advancement can be illustrated using the "*values-riches*" model[52]. It allows for a simultaneous representation of real and nominal variables and for identification of the proper interplay between them. The main factors of economic growth include: lower time preference (a boost in investments), technological progress, and increased labour resources.

Technological progress is reflected by a shift of the production function and a rise in the annual output of goods and services for a given period of production (when time preference changes). In view of the fact that technological progress increases average income, time preference should also change. When technical progress remains 'neutral', the interest rate and the C/I ratio remain constant. When the level of technical progress becomes favourable to investment, thanks to higher income, the rate of savings by economic entities grows and more investments are made.

In the case of the state of technical progress which favours consumption, the situation is reversed. Customers become wealthier thanks to technolog-

ical improvement and are eager to spend more on consumption (time preference increases). The stages of production become shorter, while interest rates and the C/I ratio grow.

This mechanism is associated with the endogenous approach to development, where internal factors trigger subsequent phases of growth. Low time preference might become even lower in further stages, leading to higher investments and economic growth. Of course, such a process cannot continue for extended periods of time, which stems from the assumption that successive drops in time preference are a consequence of rising production and income. In the long term, this trend is not always possible to sustain.

This kind of technological progress is often observed in the case of state interference involving debt financing. It tends to be characterised by implementation of improvements rather than radically new production solutions (the increasing propensity of consumers to possess more goods) and results from rising consumer spending. Enterprises do not seek changes oriented at lowering (process) costs because the interference ensures a steady flow of financial resources. Among the long-term consequences of this state of affairs is the cyclical character of technological changes and increased burden on consumers in the future, which in turn raises time preference and dampens the willingness to invest.

Transforming higher-order goods into lower-order ones implies a causal relationship, which in turn has much to do with time. The time intervals between the particular phases of transformation of goods should gradually become shorter. Not only would this prove that the production means have improved, but above all that technical progress has taken place. Obviously, time will never cease to play a significant role, but the cycles of transformation of goods ought to be successively shorter. Goods of higher order acquire their character not because of the needs existing now, but because of future needs, which appear only after a production cycle is completed and whose emergence can be predicted.[53]

The accuracy of predicting the future quality and quantity of goods depends on the level of knowledge about the elements of the causal chain which are used in the production process, and on the degree of control over these elements. This is associated with the uncertainty which determines the quantity/quality ratio. The higher the number of incomprehensible or uncontrollable components of the production process, the greater this uncertainty.[54]

Particular kinds of knowledge are used by entities which have control over resources and can define the purposes these resources are to serve,

or, in other words, which values should be given priority. This is why only individuals are capable of independent pursuit and realisation of their needs since only themselves can accurately assess the amount and type of goods they require.[55] Therefore, technological progress arises from the activity of individuals, lack of restrictions in planning, and free competition, which prevents the emergence of technological monopolies.

The growth of innovation correlated with time preference also reflects the availability of capital and the way in which it is used as these influence productivity of labour, real wages, and a broadly understood standard of living. The degree and scope of the capital used determines technological progress, which in turn has a bearing on the size of the supply of goods. Increasing supply makes goods and services more affordable to business entities, thus influencing their quality of life. This dependence also applies to capital goods.

Accumulation of capital is a key factor of technological growth. For technological improvement to occur, at least an equal amount of today's capital goods must be utilised for producing future capital goods. The process of sustainable accumulation can rely on savings and the capital/income ratio – provided that two conditions are met[56]:

1. An adequate proportion of produced goods is used for generating capital goods, i.e., an amount greater than that which would merely make it possible to replace the capital goods used for production; this depends on the ratio of capital goods demand to consumer goods demand, that is on the level of net savings in relation to consumer spending.
2. Diminishing returns of scale associated with an increase in capital goods given the same amount of labour must be counterbalanced by technical progress.

This is closely related to maintaining a steady growth of the supply of capital goods. When the amount of capital goods rises and accumulation of capital takes place, the overall standard of living is guaranteed to grow freely and steadily.

Technological progress will increasingly benefit those economies which have rising capital/income ratios. An increasing C/I ratio indicates greater ability to utilise savings, or to invest them more profitably, particularly in longer production periods. Therefore, economic systems with higher savings and larger accumulated capitals are more capable of taking advantage of technical progress. Greater capital intensity enables them to introduce more complex and far-reaching technological changes.

Technological progress is so inseparably linked with the level of accumulated capital that there is a feedback loop between these two categories.

To make accumulation possible, technical progress transfers diminishing returns of scale onto other groups of capital goods, whereas, on the other hand, accumulation of capital is indispensable for creating new technological solutions.

Many 'mainstream' economists claim that production technologies depend on the current state of technical knowledge. The Austrians demonstrate that it is rather the supply of capital goods available at a given moment that determines the choice of one out of many known production technologies.[57] According to Mises, what poses an obstacle to technical progress (or technological innovation) is not lack of technical knowledge but scarcity of necessary capital to replace obsolete production facilities with more advanced equipment available in better developed countries. To catch up with more innovative economies a country must begin with accumulating savings which would enable it to employ production factors in more time-intensive manufacturing processes. "Only then could they successively produce the tools required for the construction of those plants which in the further course were to produce the equipment needed for the construction and operation of modern plants..."[58].

A dearth of capital can be offset by acquiring ready-made capital goods from more developed countries, which helps shorten the phase of saving and accumulating and makes use of new technologies sooner. "An increment in capital goods available makes it possible to attain temporally remoter ends without being forced to restrict consumption. A loss in capital goods, on the other hand, makes it necessary either to abstain from striving after certain goals which one could aim at before or to restrict consumption. To have capita1 goods means, other things being equal, a temporal gain."[59].

Possession of a larger amount of capital ensures a market advantage, thanks to which an entrepreneur can outdo competitors. He can purchase and use technological solutions much earlier, thus gaining a sort of 'monopolistic rent'.

So technical progress relies on maintaining the ability to increase the supply of goods and services by means of additional reserves of capital goods.[60] Thanks to technological sophistication, prices fall, but this does not affect the profit margin in any way.

Although Joseph Schumpeter is not strictly associated with Austrian economics, his participation in Böhm-Bawerk's seminars[61] and the convergence of some of his views with those of the Austrians justifies a presentation of his theory in this chapter. It should be noted, however, that his opinions on most of the issues discussed below provide a counterpoint to the achievements of the leading representatives of the Austrian School.

For Schumpeter, technological progress means innovation, closely related with entrepreneurial activity. Formally, it is the creation of a new production function which combines particular factors of production in a 'novel fashion'. The new combination of production factors, in his view, does not take into account those parts of the innovative process which are but a form of routine within a given function of production.[62] Moreover, he does not believe that innovation can be measured based on the behaviour of production function coefficients, and is even less inclined to think that every innovative solution reduces these coefficients, even if it is interpreted through their prism.

Innovation is also defined by means of financial categories. The total cost borne by enterprises (excluding innovations and given constant prices of production factors) grows monotonically along with production. The occurrence of innovation makes it possible to produce the same volume of output at a relatively lower cost. In a production process, innovation reduces the long-term marginal cost, or even makes it negative.[63]

Schumpeter's definition of innovation is very inclusive. He claims the notion encompasses[64]: introduction of a new product (or a new version of this product), implementation of a new production method, a new market (one in which a given branch of industry has not been present, irrespective of whether the market existed previously), gaining new sources of raw materials or semi-finished products, regardless of whether the source previously existed or not, as well as changes in the organisation of a market, such as the emergence of monopolistic structures or, conversely, breaking of a monopoly.

This approach classifies as innovation practically all technical and economic changes which are part of technological progress.

Taking into consideration the mutual interplay between them, the greatest significance should be assigned to those innovations which, being a component of technological development, usher in qualitative changes. Without them, technological progress is only a reproduction of old methods.

From the temporal point of view, Schumpeter claims, innovation is nothing but the original economic realisation of an invention which is at its root, i.e., implementation. On this basis, he divides technological changes into three categories (the so-called Schumpeter's triad): 1) invention, 2) innovation, and 3) imitation. To make an invention useful, a certain input is required. It allows the invention to be transformed into a technological output taking the form of innovation in manufacturing processes and products, which are then diffused in the company, across the sector, or on a national or global scale. This mechanism is measured by the amount of research and

development (R&D) expenditure, and its final outcome is assessed by the number of innovations (patents, licences, know-how).[65]

What determines the character of technological change are the factors which influence the level and pace of the growth of technical knowledge: process and product innovations (supply-induced). Schumpeter emphasises the role of the supply sources of technological progress, i.e. ones which lie outside companies.

According to him, economies generate steady streams of inventions because of continuous technological progress fostered by appropriate innovating entities. This, in turn, is supposed to lead to economic growth.

Schumpeter's theory of innovation, focused on the production function, did not have analytical significance. Nevertheless, it became a basic theoretical model of the neo-classical theory of growth and technical progress, and a benchmark for all the changes in factor input ratios and their impact on production volumes.

Conclusion

In comparison with mainstream economics, the Austrian School attached greater importance to time, capital and technical progress as fundamental factors of human activity. The assumption of 'human action', which lies at the core of the Austrian approach, allows for a precise analysis of economic processes. This follows from the fact that the principles governing people's activity are not confined to a specific time or place. Their impact is identical in different economies and on different people (...) since the laws and rules of human action apply universally wherever people take decisions. And thus they make it possible to conduct reliable economic research.[66] It is worth remembering that for a long time the achievements of the Austrians (largely theoretical in nature) remained outside the focus of serious scientific study, overshadowed by mathematised academic economics.

The authors of this article are convinced that the heritage of the Austrian School of Economics as regards the significance of time, capital, and technological progress for business is anything but obsolete. According to the representatives of this school, the passage of time shows us that human activity is dynamic in nature. Today capital is a crucial production factor used for manufacturing all kinds of goods (of higher and lower order). Technological progress, an amalgamation of the previous two categories, is one of the most vital forces behind rapid and steady economic growth.

A correct interpretation of the theoretical achievements discussed above can contribute to a proper understanding of the modern economy and shape its development. We hope that the reflections of the prominent representatives of Austrian economics which we have recalled here will trigger more in-depth studies into the notions of time, capital and technological progress.

NOTES

[1] S. Czaja, *Czas w ekonomii*, Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Wrocław 2011, p. 10.

[2] *Modern Economic Thought*, S. Weintraub (ed.), Oxford University Press, Oxford 1997, p. 20, as cited in: S. Czaja, *Czas w ekonomii*, Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Wrocław 2011, p. 10.

[3] S. Czaja, *Czas w ekonomii*, Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Wrocław 2011, p. 10.

[4] L. von Mises, *Theory & History*, Ludwig von Mises Institute, Auburn, Alabama 2008, p. 285.

[5] L. von Mises, *Theory...*, *op. cit.*, p. 286.

[6] L. von Mises, *Theory...*, *op. cit.*, p. 294.

[7] H. Hazlitt, *Economics in One Lesson*, Ludwig von Mises Institute, Auburn, Alabama 2008, p. xi–xii.

[8] F. Bastiat, *Harmonie ekonomiczne*, Nakładem tłumacza w Drukarni Helmutha Henklera, Drezno 1867, p. 278.

[9] E. Böhm-Bawerk, *Capital and Interest. A Critical History of Economical Theory*, MacMillan and Co., London 1890, p. 258.

[10] C. Menger, *Principles of Economics*, Ludwig von Mises Institute, Auburn Alabama 2007, p. 67.

[11] L. von Mises, *Human Action. A Treatise on Economics*, Fox & Wilkes San Francisco 1963, p. 100.

[12] L. von Mises, *Human...*, *op. cit.*, pp. 103–104.

[13] L. von Mises, *Human...*, *op. cit.*, pp. 479–483.

[14] L. von Mises, *Human...*, *op. cit.*, p. 484.

[15] Cf. H. H. Hoppe, *Democracy. The God That Failed*, Transaction Publishers, New Brunswick, New Jersey 2007, p. 1.

[16] H.H. Hoppe, *op. cit.*, p. 3–5, 10.

[17] F. von Hayek, *Individualism and Economic Order*, The University of Chicago Press, Chicago, Illinois 1958.

[18] *PWN*, https://encyklopedia.pwn.pl/haslo/kapital;3920041.html.

[19] *Britannica*, Kenneth E. Boulding, Jan Pen, Paul Lincoln Kleinsorge, Hans Otto Schmitt (https://www.britannica.com/topic/capital-economics).

[20] Cf. R. Hardin, *Trust*, Polity Press, Cambridge 2006, Chapter 4.

[21] *Britannica*, Kenneth E. Boulding, Jan Pen, Paul Lincoln Kleinsorge, Hans Otto Schmitt (https://www.britannica.com/topic/capital-economics).

[22] J. Brémond, M.-M. Salort, *Leksykon wybitnych ekonomistów*, Wydawnictwo Naukowe PWN, Warszawa 1997, p. 44

[23] W. Stankiewicz, *Historia myśli ekonomicznej*, PWE, Warszawa 2007, p. 190

[24] W. Stankiewicz, *op. cit.*, p. 359.

[25] W. Stankiewicz, *op. cit.*, p. 192.

[26] Britannica, Kenneth E. Boulding, Jan Pen, Paul Lincoln Kleinsorge, Hans Otto Schmitt (https://www.britannica.com/topic/capital-economics).

[27] E. Böhm-Bawerk, *Kapitał i zysk z kapitału. Dział pierwszy. Historia i krytyka teorii zysku z kapitału*, Kraków 1924, pp. 5–6.

[28] E. Bohm-Bawerk, *op. cit.*, pp. 5–6.

[29] E. Bohm-Bawerk, *op. cit.*, pp. 5–6.

[30] W. Stankiewicz, *op. cit.*, pp. 365.

[31] H. Landreth, D.C. Colander, *Historia myśli ekonomicznej*, PWN, Warszawa 2005, pp. 282–283.

[32] M. Skousen, *Walc wiedeński na Wall Street. Ekonomia Austriacka dla inwestorów giełdowych*, Fijorr Publishing Company, Warszawa 2014, p. 34.

[33] L. von Mises, *Human...*, *op. cit.*, p. 494.

[34] L. von Mises, *Human...*, *op. cit.*, p. 260.

[35] L. von Mises, *Human...*, *op. cit.*, p. 260.

[36] L. von Mises, *Human...*, *op. cit.*, p. 494–495.

[37] L. von Mises, *Human...*, *op. cit.*, p. 495.

[38] L. von Mises, *Human...*, *op. cit.*, p. 260.

[39] F. von Hayek, *The Pure Theory of Capital*, Ludwig von Mises Institute, Auburn, Alabama, 2009, p. 294 et seq.

[40] F. von Hayek, *Pieniądz i kryzysy, dzieła wybrane*, Vol. I, Instytut Ludwiga von Misesa, Warszawa 2014, pp. 400–401.

[41] R. Taghizadegan, *Szkoła austriacka – praktyka inwestowania. Między inflacją a deflacją*, Fijorr Publishing, Warszawa 2017, p. 151.

[42] Cf. J.H. de Soto, *Spór metodologiczny (Methodenstreit) Szkoły Austriackiej*, https://mises.pl/pliki/upload/methodenstreit.pdf.

[43] F. von Hayek, *The Pure...*, *op. cit.*, p. 294.

[44] L.M. Lachman, *Capital and Its Structure*, Ludwig von Mises Institute, Auburn, Alabama 2007, pp. 12–17.

[45] Cf. J.A. Schumpeter, *The Theory of Economic Development*, Galaxy Book New York, p. 65.

[46] Cf. M. Blaug, *Economic Theory In Retrospect*, Cambridge University Press, Cambridge 1985, pp. 498–506.

[47] Cf. A.Heertje, *Economics and Technical Change*, Wiedenfeld London 1973, pp. 83–84.

[48] Cf. S. Jevons, *The Theory of Political Economy*, Macmillan London 1888, Vol. 7, available at: www.econlib.org.

[49] L. von Mises, *Human...*, *op. cit.*, p. 520–523.

[50] Cf. H. H. Hoppe, *op. cit.*, p. 2.

[51] Cf. H. H. Hoppe, *op. cit.*, p. 6.

[52] R. Fillieule, *The "Values-Riches" Model: An Alternative to Garrison's Model in Austrian Macroeconomics of Growth and Cycles*, "The Quarterly Journal of Austrian Economics", Vol. 8, No. 2/2005, pp. 3–19.

[53] C. Menger, *op. cit.*, pp. 67–68.

[54] C. Menger, *op. cit.*, p. 71.

[55] Hayek von F., *The pure...*, *op. cit.*

[56] G. Reisman, *Kapitał i kapitalizm XXI wieku*, Fijor Publishing 2015, p. 49.

[57] F. von Hayek, *The Pure...*, *op. cit.*, p. 48.

[58] L. von Mises, *Human...*, *op. cit.*, p. 496.

[59] L. von Mises, *Human...*, *op. cit.*, p. 497.

[60] G. Reisman, *op. cit.*, p. 56.

[61] M. Machaj, *Joseph Alois Schumpeter*, in: R. Ciborowski, A. Kargol-Wasiluk, M. Zalesko (eds), *Ekonomiści szkoły austriackiej*, Instytut Studiów Regionalnych, Białystok 2011, p. 105.

[62] Cf. J.A. Schumpeter, *Business Cycles, A Theoretical, Historical and Statistical Analysis of Capitalist Process*, Porcupine Press 1939, Vol. 1, pp. 87–93.

[63] Cf. J.A. Schumpeter, *Business Cycles...*, *op. cit.*, p. 94.

[64] Cf. J.A. Schumpeter, *The Theory...*, *op. cit.*, p. 66.

[65] Cf. J.A. Schumpeter, *Business Cycles...*, *op. cit.*, pp. 93–95.

[66] R. Ciborowski, A. Kargol-Wasiluk, M. Zalesko (eds), *Ekonomiści szkoły austriackiej*, Instytut Studiów Regionalnych, Białystok 2011, pp. 5–6.

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